## EVEN MORE

Since this manual was written EVEN MORE facilities have been added to the Final Cartridge....Read on....

This version of the Final Cartridge can be used with either Commodore OR Centronics printers. To use the TYPE Command on a Commodore printer enter OPEN1,4,7 RETURN. Then enter the word TYPE and press RETURN. If you wish to use upper and lower case text press CBM and SHIFT before typing. Your keyboard will now act just like a normal typewriter. To print press RETURN. With Centronics printers follow the manaul.

## SCREEN DUMPS

After pressing F7 from the FREEZE MENU the picture will return as normal. You may NOW change the background and foreground colours and choose your printer type. Pressing F1 will alter the background colours and F3 alters the foreground colours. Continually pressing either key will return you to the original colours. Press either F5 for Centronics printers or F7 for Commodore 801 or 803 printers. Next choose either F1 for a normal print or F3 for a reverse print. PLEASE NOTE:- When using Commodore printers the printer MUST be switched OFF and then ON again before choosing normal (F3) or reverse print (F1) this is to reset the printer. It is advisable to reset the printer again after a screen dump by switching the printer off. You can exit the FREEZE MENU by pressing RETURN.

## SPRITE KILLER

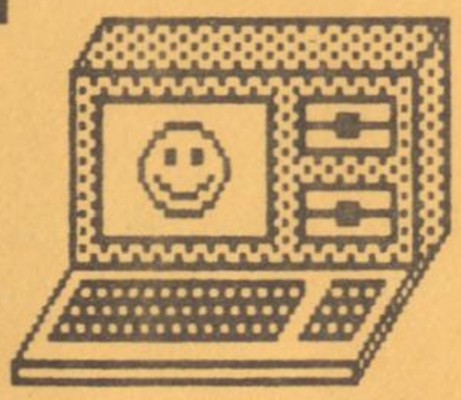
Pressing CBM key and RESTORE freezes the program. You can then press CRS up/down key to kill Sprite to Sprite collision detect OR CRS left/right to kill Sprite to background detect. After choosing one of the above options the program will continue after approximately 20 seconds. Please note NOT ALL PROGRAMS that use Sprites use Sprite to Sprite colision detect so don't be surprised if you are still killed and what may appear to be sprites may not be.

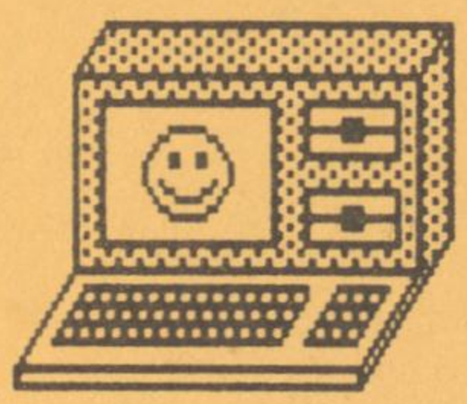
## MONITOR

Typing 04 (that is 'O' NOT ZERO) whilst in the MONITOR will switch out all ROMs. The RAM under the ROMs can now be examined. To return to normal type 07.

## DISK MONITOR

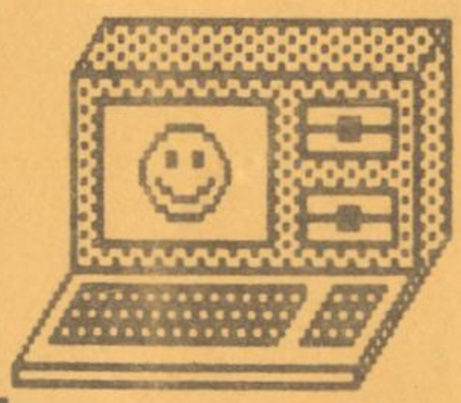
Whilst in the normal monitor it is now possible to read and write information to and from disc . To read a track or sector of a disc enter *R TRACK SECTOR in HEX. So to read track 18 sector 1 you would enter:- *R 12 01. The contents of the track and sector you chose is now stored at CF00 onwards. To look at the contents type M CF00. You may now change the contents. To RESAVE the track and sector type *W TRACK SECTOR. Please note a space must be left between *R or *W and between the track and sector number. WARNING !!! Practice on an old disc BEFORE using the disc monitor.

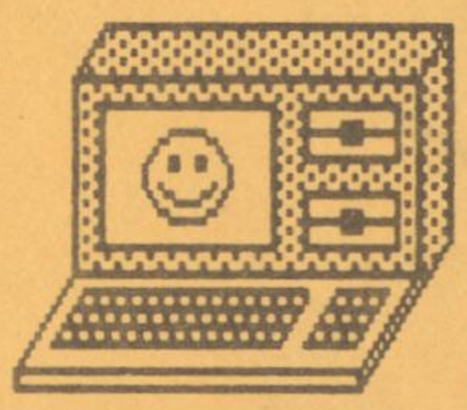




# THE FINAL CARTRIDGE

# MANUAL





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Home & Personal Computers will not be held responsible for any damage caused to any equipment caused due to misuse of their products. Every care should be taken to ensure that The Final Cartridge and any associated hardware (eg Centronics printer cable) are used correctly.

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Overall software and hardware development by Wil Sparreboom.

Code written by Uwe Stahl and Wil Sparreboom.

Board design and logic by Ton Peters, Jacques van Schajik and Wil Sparreboom.

## CONGRATULATIONS!

You are now the owner of The Final Cartridge, the most useful utility ever produced for the Commodore 64 and 128. The Final Cartridge gives you many useful toolkit commands, allows you to use 24K of RAM which has never before been so easily usable, has a disk turbo which loads and saves FIVE TIMES faster, a tape turbo which loads and saves TEN TIMES faster, gives you proper disk commands, has a built-in machine language monitor, allows you to use a Centronics printer to produce listings and high-resolution graphics screen dumps and gives you function keys that work!

Perhaps the most important feature of The Final Cartridge is the fact that it operates completely outside the computer and so uses none of its memory. In the unlikely event that you find some software that will not work with The Final Cartridge in use you can simply switch the cartridge off - you never need to unplug it from the cartridge port, and will probably never want to!

The Final Cartridge also has a reset switch which will allow you to recover control of your computer at any time, and an OLD command so that you can get your BASIC program back after a reset or NEW.

This manual will guide you through the amazing features of The Final Cartridge and will later act as a reference guide to using the last utility cartridge you will need to buy.

## GETTING STARTED

### Commodore 64

Plug the Final Cartridge into the cartridge port of your computer (right hand side as you look from the front) with the label up and the switch to the left. Turn on the computer and other peripherals as normal.

### Commodore 128

Plug cartridge in as described above, then turn on your C128 with the Commodore key held down. You will see Freeze Menu 2 displayed on the screen. Press F3 to go into standard C64 mode (cartridge is disabled in this mode), or F4 to go into C64 mode with the cartridge enabled. PLEASE NOTE - The Final Cartridge WILL NOT WORK in C128 or CP/M mode, and must be switched off (switch to the right) when using these modes.

Once you have followed the above instructions and turned your computer on you will see the start-up screen displaying the words FINAL CARTRIDGE 84K RAM/ROM.

### The Function Keys

The eight function keys all now have commands assigned to them. These are as follows:-

| | |
|---|---|
| f1 | LIST |
| f2 | MONITOR |
| f3 | RUN |
| f4 | FLOAD |
| f5 | DLOAD |
| f6 | DSAVE |
| f7 | SYS"$ |
| f8 | SYS |

You can use the function keys to speed up the loading of programs from disk considerably. The most convenient way to load a program is to press function key f7 to get the disk directory, then move the cursor up to the program which you would like to load and then press f5 (or f4 for a program saved using the freeze facility). The program will then be loaded in at 5 times normal speed. You may then press f1 to LIST the program or f3 to RUN it.

The new commands which are assigned to the function keys will be explained in full in the following pages.

## The Freeze Menus

If at any time you press the RESTORE key you will be presented with a menu, as follows:-

```
        FREEZE MENU

F5=DISC SAVE    F7=SCR.DUMP
F6=TAPE SAVE    F8=MENU 2
```

You should ignore this menu for the time being, it is explained at a later stage in this manual. However, if you press f8, you will see this menu displayed:-

```
        FREEZE MENU

F1=RESET        F3=STAND.64
F2=MONITOR      F4=START UP
```

If you then press any of the function keys, f1, f2, f3 or f4, the following will occur:-

f1 (reset) - this will perform a complete reset, as if pressing the reset button on the cartridge.

f2 (monitor) - this will take you into The Final Cartridge's built-in monitor, which is explained fully in it's own section near the end of this manual.

f3 (standard 64) - this will disable the cartridge and return to normal C64 mode. If a program was running when you pressed the RESTORE key it will continue where it left off after you press f3.

f4 (start up) - this will turn the cartridge on and perform a complete reset.

If you press RETURN on the first freeze menu you will be returned to C64 mode with the cartridge enabled, and any program which was running will continue where it left off.

## THE TOOLKIT COMMANDS

The Final Cartridge has several toolkit commands which make programming much faster and easier. These commands allow you to renumber a program, find a string, word or command, delete blocks of lines, recover a NEWed program, give you automatic line numbering, tell you where an error occurred, and append one program onto the end of another.

AUTO

If you are typing in a program from a book or magazine then it can become very boring having to type in the line numbers, especially if they are evenly numbered (ie 10, 20, 30 etc). The Final Cartridge will AUTOmatically number your program lines, making the typing in of programs much faster and easier. For example,

```
AUTO 10,20
```

will print the number 10 on the screen, so that you may enter line 10 of your program, and when you press RETURN the number 30 will appear, and so on. When you have come to the end of the program just press RETURN without entering a command.

The first number after the AUTO command tells the computer the first line number of your program, and the second number tells it how much each line is to be increased by. So the command:-

```
AUTO 50,5
```

will give you line numbers in increments of 5 starting at line 50.
If you just type in AUTO and then press the RETURN key then you will be given AUTOmatic line numbering starting at line 100 and going up in steps of 10.

DEL

Imagine that you are writing a long program and you decide that you do not need a particular routine which is about 20 lines long. To delete these lines the conventional way (ie by typing the line number of each line to be erased) would take quite a long time. However, The Final Cartridge saves your fingers and your computer's keyboard from all this extra work by providing a DELete command.

The format for the DEL command is very similar to that of the LIST command, so for example, to DELete all program lines up to and including line 50, you would type in:-

```
DEL -50
```

To DELete all lines between 150 and 225 you would type in:-

```
DEL 150-225
```

And to DELete all lines from line 452 onwards you would type in:-

```
DEL 452-
```

OLD

If you have typed NEW by mistake or have pressed the reset button all is not lost. To save the agony of having to re-type the whole program, The Final Cartridge has an OLD command which will recover a BASIC program after a reset or NEW. This command is very simple to use - just type OLD and your program will be back, as long as you haven't started to type in a new program or to LOAD one in.

RENUM

The RENUM command is very useful for when you are writing your own programs as it allows you to tidy up the line

numbers. Imagine, for example, that you are writing a program and have been numbering the lines in steps of 10. You then discover that you need to add 15 lines between lines 50 and 60. There is obviously no way that they will fit, so what do you do? You simply use the RENUMber command built into The Final Cartridge. Using this command you could RENUMber the whole program in steps of 20 - giving you plenty of room to fit in those extra 15 lines. The RENUM command is used in this way:-

```
RENUM 10,20
```

This command will RENUMber the whole program in increments of 20, starting with line 10. The first number after the RENUM command is the starting line, and the second number tells the computer how much to increase each line number by. RENUM also takes care of any GOTOs and GOSUBs. Like AUTO, this command defaults to RENUM 100,10.

FIND

How many times have you tried to find a particular string in the middle of a very long program? The FIND command will search through the whole program for a string, word or command and list every line in which it occurrs. For example, the command:-

```
FIND "THE FINAL CARTRIDGE"
```

will list every line containing the string 'THE FINAL CARTRIDGE'.

```
FIND GOTO
```

will list every line containing the command GOTO.

```
FIND N$
```

will list every line containing the string variable N$.

HELP

The HELP command is very useful when you are trying to debug a program. If an error occurs then you simply have to type HELP and the offending line will be displayed on the screen. This command will only work after an error has occurred.

APPEND

Imagine that you are writing a program, and suddenly realise that you have a routine SAVEd on tape which you would like to include in your program. Normally it would be extremely difficult to get this routine from tape onto the end of your program, but the APPEND command makes this task very easy. You simply to type APPEND to load the first program on tape, or APPEND"program name" to load a particular program, and the routine will be LOADed onto the end of the program already in memory. If you now type LIST you will see that you now have two prgrams loaded into memory, and the original line numbers are unchanged. You may then RENUMber

the new program and re-SAVE it to tape or disk.

## THE DISK COMMANDS

The 1541 disk drive is renowned for it's slow saving and loading speeds, and the difficulty which is encountered whenever you want to carry out any 'housekeeping' tasks (eg scratching a file, formatting a disk etc). The Final Cartridge solves many of these problems using the following commands:-

### SYS"$

Having to type LOAD"$",8 and then LIST every time you want a directory of the disk can be very time-consuming, and of course, this process wipes out any program you may have had in memory at the time. However, you can now forget all this inconvenience, as The Final Cartridge has an SYS"$ command, which will display a directory of the disk on the screen WITHOUT wiping out the program currently in memory. The command is extremely easy to use - just type SYS"$ OR press f7 and then press the RETURN key, and the directory of the disk will be displayed on the screen.

### DAPPEND

This command is very similar in operation to the cassette-based APPEND command. Imagine, for instance, that you have two programs which you would like to join together. With the Final Cartridge this couldn't be easier. All you have to do is load in the first program as normal (or type it in), then type DAPPEND"program name", where 'program name' is the name of the second program', press RETURN and the second program will be appended onto the end of the one in memory. If you LIST the new program you will see that this is in fact the case. You may then RENUMber the complete program and re-save it to disk or tape.

### SYS"

It is quite a long, boring process to format a disk, scratch a record, rename a file, or, in fact, carry out any 'housekeeping' tasks using the disk drive. Using the SYS" command built into The Final Cartridge, however, you can quickly and easily use any of the features built into the 1541 which would normally be carried out by an OPEN 15,8,15:PRINT#15,"... command. For example, to scratch a program called 'FROG' from a disk you would simply type:-

SYS"SCRATCH0:FROG"

or even

SYS"S0:FROG"

To format a disk called UTILITIES 1, with an ID number 01, you would simply type:-

SYS"NEW0:UTILITIES 1,01"

If an error occurs whilst using the disk drive the only

indication you have that an error has occurred is the red light flashing. To find out what kind of error has occurred you simply have to type SYS" and press RETURN.

The SYS" command can be used with any of the disk commands listed in the 1541 User's Manual.

DLOAD

If you want to load a program from disk you normally have to type LOAD"program name",8 or LOAD"program name",8,1. With The Final Cartridge, however, you simply have to type DLOAD"program name (you don't have to close the quotation marks). To load a program from a drive with device number 9 you would type LOAD"program name",9. DLOAD will load a program from disk 5 times faster than normal, and will also display the start and end locations of the program being loaded in.

DSAVE

This command, as you may have guessed, is used to save programs to disk. It is used in the same way as the DLOAD command, so to save a program called 'UTILITY' to disk you would type DSAVE"UTILITY" and press RETURN. Again, to save a program to a drive with device number 9 you would type DSAVE"program name",9. DSAVE will save a program to disk from 3 to 5 times faster than normal, the time differences being due to any re-organisation of the disk which is necessary when a program is saved.

DVERIFY

DVERIFY"program name" has exactly the same effect as VERIFY"program name",8. In other words, the computer will compare the program on disk with the name 'program name' with the one currently in memory. If the two programs are the same then the computer comes back with the usual 'READY' prompt, but if there are any differences then a 'VERIFY ERROR' is given. DVERIFY works at the normal slow speed.

## THE TAPE TURBO

Tape users will no doubt be aware of the problems with the Commodore 64's slow loading speed. However, you will no longer have to wait great lengths of time while your programs are loading or saving, as The Final Cartridge has a turbo load and save routine which loads and saves TEN TIMES faster than normal.

The tape turbo routine replaces the normal load and save routine, and is activated as soon as you switch your Commodore 64 or 128 on with The Final Cartridge inserted and switched on. This means that all the normal tape commands (ie LOAD, SAVE, PRINT#, GET#, INPUT# etc) work as normal.

If you want to load a normal speed tape you simply have to type KILL (see below). All The Final Cartridge's functions are then disabled and you can load and save at normal speed.

Once you have loaded in your program you can simply switch the cartridge on and save your program to tape at turbo speed.

One very important point to note is that the tape turbo load will only work on programs that have been saved using the cartridge turbo. This means that commercial software saved either at normal speed, or with another turbo routine, CANNOT be loaded any faster until it has been resaved using the cartridge turbo. To do this would involve the speeding up of the cassette motor, which cannot be done by the computer.

## OTHER USEFUL COMMANDS

The Final Cartridge has some other commands which you will probably find very useful.

### LIST

The LIST command has now been improved so that any list protections which may be included in a BASIC program will be removed. This command is still used in the normal way. Pressing function key f1 also performs the LIST command.

### MONITOR

This command activates the machine-language monitor which is built into The Final Cartridge. Pressing function key f2 also has the same effect. Full details on how to use this excellent feature are given later on in this manual.

### KILL

We hope that you will never need to use this command, but it is included in case you do. Typing the command KILL will disable all the extra commands and facilities built into The Final Cartridge. To re-enable the cartridge, simply press the RESTORE key, then the RETURN key.

### TYPE

This command turns your Commodore 64 or 128 and printer into an electronic typewriter. TYPE is explained fully later on in this manual.

### USING HEXADECIMAL

The Final Cartridge allows you to use hexadecimal numbers in your programs, just as you would use decimal numbers. To tell the computer that a particular number is in hexadecimal you should precede it with a $ symbol. For example, this routine will fill the screen with @ symbols:-

```
10 FOR N=$0400 TO $07E8
20 POKE N,0
30 NEXT N
```

The start and end locations of the screen are given in hexadecimal in this program, and so are preceded by $ symbols.

## THE KEYBOARD

When The Final Cartridge is in use some of the keys on your Commodore 64 have new uses assigned to them. These are described below:-

### CTRL

Pressing the CTRL key while a program is listing will pause the listing until you release the key.

### CTRL HOME

If you hold down the CTRL key and press the HOME key then the cursor will jump to the bottom left-hand corner of the screen.

### CTRL DEL

Holding down the CTRL key and pressing the DEL key will erase everything to the right of the cursor on the same line.

## THE CENTRONICS PRINTER INTERFACE

(Please ignore this section if you have a Serial version of the cartridge)

The Final Cartridge allows you to use a Centronics printer instead of a Commodore printer if you have a suitable cable (these are available from H & P Computers). Using this you can print high-resolution screen-dumps, low-resolution (ie text) screen-dumps, listings including all the Commodore graphics symbols, and, in fact, do everything you can do with a normal Commodore printer and more.

### USING THE INTERFACE

The device number for the Centronics printer is still 4, as The Final Cartridge will sense that a Centronics printer is present and send everything to that in preference to a Commodore printer. However, a secondary address must also be used to tell the computer what you want to do.

The Centronics interface is very easy to use - just follow the steps below, which give an example of how to use the interface:-

(1) Connect the printer to your Commodore 64 or 128 using the Centronics cable. One end of this cable has a 'D' plug on it which fits into the back of your printer. The other end has a connector which will fit into the User Port of your computer (MAKE SURE THAT THE COMPUTER IS SWITCHED OFF BEFORE YOU DO THIS!).
(2) Turn on the printer and computer and type in the command OPEN 1,4,4:CMD 1 and press the RETURN key. The word READY should be printed by your printer. If instead you get a 'DEVICE NOT PRESENT ERROR' then you will first have to initiallise your printer with a POKE. If you have an Epson

printer then you should type POKE 56332,128, or if you have a Smith Corona printer then type POKE 56332,ASC("5"). You should then type CMD 1 again.
(3) Type PRINT #1,"THIS IS A TEST" and press RETURN. The message 'THIS IS A TEST' should be printed by your printer. You can type anything you like in place of the message 'THIS IS A TEST', including any of the Commodore graphics symbols, and they will be printed.
(4) If you have a program in memory then type LIST and the program will be printed out in full by your printer.

The OPEN 1,4,4 command told the computer to open a file to the printer, and give that file the number 1 (this is so that you can have several files open to various peripherals at the same time). The first 4 tells the computer that you want to use the printer, and the second 4 is a 'secondary address' which tells the computer that you want to print all the Commodore graphics, normal characters and control codes, just as if you were using a normal Commodore printer. There are 7 different secondary addresses which you can use:-

0 - this secondary address should only be used with an MPS 803 printer or printer program.
1 - same as 0
2 - this secondary address allows you to use all normal ASCII codes.
3 - this allows you to use all ASCII codes, as well as the control code used by your printer.
4 - using this secondary address you can print all the Commodore graphics and control codes.
5 - same as 4 except that all characters are printed in reverse.
7 - again, don't use this unless you have an MPS 803 printer.

You can, of course, change the density setting of your printer in order to produce larger or smaller text. To do this you simply POKE memory location 56332 with the control code which your printer requires to change the density setting. For example, to set an Epson printer to double-density mode you would type POKE 56332,ASC("L") and press RETURN, as L is the Epson code for double-density mode. You should consult your printer manual for the correct codes.

## MAKING SCREEN-DUMPS

(Centronics and Serial printers)

If your printer has a bit-map mode then you can produce a screen-dump of either the text screen or the high-resolution graphics screen. This is very easy to do - all you have to do in order to produce a text screen-dump is press the RESTORE key and then press function key f7. You can then sit back while the printer makes a hard copy of the screen. If you have the serial version of the Final Cartridge then you can also press CTRL and RETURN at the same time for a smaller screen dump.
Producing a screen-dump of a high-resolution screen is just

as easy. To do this you should follow these steps:-

(1) Load the program you would like to print into your Commodore 64 or 128.
(2) When the screen you want to print is on the screen press the RESTORE key.
(3) For a normal screen dump press function key f7. If you would prefer an inverse screen dump then hold the CTRL key down and press the f7 key instead.
(4) Most programs will continue to run where they left off when the screen dump has been printed. If they do not then once the printer has finished printing your graphics screen press f8, then f1 and the computer will reset back to BASIC.

The Final Cartridge will produce a screen-dump taking up half a page of paper, and if multi-colour graphics are used then shades of grey will be printed instead of colour.

If you are using the Print Shop program for the Epson printer then you must first POKE 56332,128 before loading the program.

TYPE

With the aid of the TYPE command you can turn your Commodore 64 or 128 and printer into an electronic typewriter. The command is very easy to use - as shown below:-

```
OPEN 1,4,2    (or OPEN 1,4,7 if you are using a Commodore printer)
TYPE
```

If you now type some text and press the RETURN key your text will be printed out. You may correct any text before it is printed out using the normal cursor control keys and the delete key. Once your text has been printed you may type some more text, and print that out by pressing the RETURN key. Once you have finished using this feature you can return to using your computer as normal by pressing the RESTORE key and then press f8 followed by f1.

## The Freeze Facility

The Final Cartridge has a facility built in to allow you to make backup copies of your tape and disk programs. Please note that this facility is only for your own personal backups, and is not designed to allow you to copy programs illegally. Also, programs saved using this facility can only be loaded back into your computer by The Final Cartridge.

To make a backup copy of your software, follow these simple steps:-

(1) Turn on your computer with the cartridge on, as described in the Getting Started section.
(2) If your program will not load with the cartridge working (eg if it is tape-based), then type KILL.
(3) Load your program into the computer as normal.

(4) Once the program is loaded and running press the RESTORE key. This will take you to the freeze menu.
(5) If you wish to save the program to disk, press function key f5. To save to tape press PLAY and RECORD on the cassette recorder, then function key f6.

Your program will then be saved.

There are a few points to note about the freeze facility. These are as follows:-

(1) Never freeze while the disk drive is running
(2) The printer must be turned off whilst saving a frozen program
(3) Always start from a 'clean' machine, since programs are saved in a compacted form and this will make sure that nothing unnecessary is saved.
(4) Always freeze the program when it is on it's start-up menu, as when you load your frozen program back from tape or disk it will run from the point at which you froze it.

Although the freeze facility works on the majority of software, some programs make use of special protection using the sound chip, which is a write only device and therefore cannot be checked for protection. Files or data that are required by a program must be transferred separately using a file transfer routine.

Frozen programs will always be saved under the name FC. You can, of course, rename your program if it was saved on disk. To do this, use the SYS" command, as follows:-

SYS"R0:newname=FC"

where 'newname' is what you want to call your program.

To load your frozen programs back in you should either type TLOAD to load from tape, or FLOAD"program name" (where 'program name' is the name of your frozen program) to load from disk. You MUST type a program name when loading from disk, unless your frozen program is the first file on the disk.

Please note that frozen programs can only be loaded back using TLOAD or FLOAD, since these programs are compacted, and also contain information on how to start them which the normal LOAD and DLOAD commands cannot interpret.

## THE MONITOR

The Final Cartridge is equipped with a very good machine-language monitor which will allow you to write your own machine-language programs. This monitor has several advanced features, such as bank switching (so that you can use the RAM which is 'under' the BASIC and Kernal ROMs) and the ability to scroll backwards and forwards through a dissassembly.

There are three ways to enter the Monitor. The first of

these is to simply type MONITOR and press RETURN. Alternatively, you could just press function key f2. The third way is to press the reset button on the back of The Final Cartridge, then press function key f2, or press the RESTORE key, then f8, and finally f2.

## THE REGISTERS

Once you have entered the Monitor you will be given a display of the various registers, looking something like this:-

```
C*
    PC  IRQ  SR AC XR YR SP
.; B39F EA31 37 40 27 84 FF
```

These registers are the Program Counter, Interrupt ReQuest, Status Register, ACcumulator, X Register, Y Register and Stack Pointer. You can obtain this information at any time simply by typing R and then pressing RETURN.

## LOOKING AT THE MEMORY

One of the simplest functions of the Monitor is to display the contents of a block of memory, both in hexadecimal format and, where possible, as a character (ie a letter, number or graphic symbol). The command to do this is M. So, for example, to display the contents of memory locations 8000 to 8100 (hexadecimal) you would type:-

```
M 8000 8100
```

The contents of these memory locations will then be displayed on the screen. The first number on each line (which is a four-digit number) is the memory address in hexadecimal. The eight two-digit numbers are the contents of that memory location and the seven memory locations following it. At the end of each line is a series of eight characters. The eight two-digit numbers are the ASCII codes of these characters.

If you want to carry on looking through the memory from location 8100 onwards you can simply move the cursor down off the bottom of the screen using the cursror-down key. The Monitor will carry on dissassembling until you release the cursor-down key. If a particular memory location that you wanted to look at scrolls off the top of the screen then you should simply use the cursor-up key to move the cursor up off the top of the screen, and you will be able to move BACKWARDS through memory.

You may only want to look at the contents of one or two memory locations, and to do this you should simply type the command M followed by the first memory location that you want to look at. The contents of this memory location, and of the seven memory locations following it will then be displayed. For instance, to look at the contents of memory locations 4000 to 4007 (hexadecimal) you would simply type:-

```
M 4000
```

Of course, if you decide that you would like to look at the memory locations before or after locations 4000 to 4007 you can move the cursor off the top or bottom of the screen accordingly.

## LEAVING THE MONITOR

Once you have finished using the Monitor you should simply type X and press RETURN. You will then be back in BASIC.

## ASSEMBLING MACHINE-LANGUAGE PROGRAMS

The Monitor has a built-in assembler which allows you to write your own machine-language programs. Try this short example program:-

```
A1000 LDA #$01
A 1002 STA $0400
A 1005 LDA #$00
A 1007 STA $D800
A 100A BRK
```

As you enter each line of this program the Monitor will alter what you have entered so that it looks like the program listing below. A letter A will also be displayed at the start of the next line, together with a memory address, ready for you to enter some more of the program. When you have finished just press RETURN. The final program will look like this:-

```
A 1000   A9 01        LDA #$01
A 1002   8D 00 04     STA $0400
A 1005   A9 00        LDA #$00
A 1007   8D 00 D8     STA $D800
A 100A   00           BRK
A 100B
```

The display now shows the memory locations used by each instruction (on the left), the assembled program (in the centre) and the un-assembled program (on the right).

## RUNNING MACHINE LANGUAGE PROGRAMS

You can execute the above program simply by typing:-

```
G 1000
```

As soon as the RETURN key is pressed a black letter A will appear in the top left-hand corner of the screen.

The G command tells the Monitor to start executing a machine language program starting at the memory location given, so the above command tells the Monitor to execute the machine language program starting at memory location 1000 (hexadecimal).

## DISASSEMBLING MACHINE LANGUAGE PROGRAMS

The Monitor built into The Final Cartridge has the ability to disassemble a machine language program (or, in other words, convert it from a hard-to-understand list of numbers

into a more readable list of commands). This is done by using the D command. So, for example, to disassemble the short program we entered above we would type:-

```
D 1000 100A
```

Or, to start disassembling a long program starting at memory location 2AFE (hexadecimal) you may just type:-

```
D 2AFE
```

This will disassemble one command only, and to continue you should move the cursor off the bottom of the screen, or alternatively move the cursor off the top of the screen (to disassemble backwards).

## SAVING AND LOADING MACHINE LANGUAGE PROGRAMS

Once you have written your machine language program you will no doubt want to save it to either tape or disk. This is very easy to do - all you have to do is tell the Monitor the name of the program, whether you want to save to tape or disk, and the start and end locations of the program. So, to save the program we wrote earlier, we would type:-

```
S "DISPLAY",01,1000,100B
```

You will probably notice that we have to add 1 to the end memory location, as the save routine will save from the start location up to, but not including, the end location.

The above command saves to tape, but to save to disk you simply have to change the device number (the 1 in the above command) to an 8, like this:-

```
S "DISPLAY",08,1000,100B
```

Loading back machine language programs is just as easy. Simply type L followed by the program name and the device number. So to load our program from tape we would type:-

```
L "DISPLAY",01
```

and to load it from disk we would type:-

```
L "DISPLAY",08
```

You can also perform a relocated load by adding a relocate address, eg:-

```
L "DISPLAY",01,4000
```

would load the program 'DISPLAY' from tape and store it in memory locations 4000 (hexadecimal) onwards. Of course, you can perform a relocated load from disk by changing the command to:-

```
L "DISPLAY",08,4000
```

## FILLING AN AREA OF MEMORY

It can often be useful to quickly fill an area of memory with a number. This is accomplished by using the F (for Fill) command. All you have to do is specify the start and end locations of the block of memory to be filled, and the value that you want to store in all those memory locations.. For example, to fill memory locations 1000 to 2000 (hexadecimal) with the value 2A you would type:-

```
F 1000 2000 2A
```

If you now type:-

```
M 1000 2000
```

## TRANSFERRING BLOCKS OF MEMORY

The Transfer command is very useful for copying a block of memory from one place to another. You can see how this command works by typing:-

```
T 0000 03E8 0400
```

As soon as you press the RETURN key the screen will fill up with 'rubbish'. This in fact the contents of the first 1000 bytes of the Page Zero RAM, as the Transfer command above copies the contents of memory locations 0000 to 03E8 (which is part of the Page Zero RAM) into memory locations 0400 onwards (which is the screen memory).

## COMPARING BLOCKS OF MEMORY

The Compare command will compare one block of memory with another, and inform you of any differences, if any. For instance, if you type:-

```
C 2000 3000 4000
```

then the screen would rapidly fill up with numbers. The numbers being displayed are the memory locations which are not the same. So if you were to compare two blocks of memory that are identical then nothing will be displayed on the screen. As normal, the first number after the C command is the start of the block of memory, the second number is the end of that block of memory, and the third number is the start of the second block of memory.

## HUNTING FOR NUMBERS

The Final Cartridge has a very useful Hunt facility. As you may have guessed, the H command will search through a block of memory for a number or group of numbers. For instance, if you were to type in:-

```
H 8000 A000 FF
```

then all the memory locations between 8000 and A000 (hexadecimal) which contain the value FF (hexadecimal). If you wanted to find all the memory locations which contain a group of values, then you would simply use a command similar

to this:-

H 7000 C000 1A 2C FD

This command will search through memory locations 7000 to C000 (hexadecimal) for the values 1A, 2C and FD (hexadecimal) in a group, and display all the memory locations in which they occur.

## PRINTING MACHINE LANGUAGE

If you want to print out a block of machine language then you should leave the Monitor (by using the X command), then type:-

OPEN 1,4,2:CMD1:MONITOR

OR, if you have a Commodore printer, type:-

OPEN 1,4,4:CMD1:MONITOR

You can then continue Assembling of Disassembling or displaying blocks of memory as normal, except that everything will go to the printer instead of the screen.

## CONVERTING HEXADECIMAL TO DECIMAL

As you will have gathered by now, the Monitor expects all numbers to be in hexadecimal. For this reason the Monitor is equipped with a decimal to hexadecimal and hexadecimal to decimal convertor. If, for example, we wanted to know what then number 40960 was in hexadecimal we would simply type:-

#40960

and the equivelant number in hexadecimal (A000) will be displayed on the screen. If you wanted to find the decimal value of, for example, 10FF you would type:-

$10FF

and the number 4351, which is the decimal equivelant of 10FF, will be displayed on the screen.

## MEMORY READ AND MEMORY WRITE

With the aid of The Final Cartridge you can access the 24K of RAM which normally lies 'under' the ROMs. This extra memory can be used as a storage medium for large amounts of information, such as variables, text and graphics screens, look-up tables etc.

There are two extra commands which enable you to use this memory - MR and MW (for Memory Read and Memory Write). Before these commands can be used, however, they must be intiallised with the instruction SYS $FEF5 (or SYS 65269 if you prefer to work with decimal numbers). These commands must be initiallised as they are not normally resident in the computer's memory so as to retain compatability with existing software. This short program illustrates the MR and MW commands:-

```
10 SYS $FEF5
20 MR1024
30 MW60000
```

If you RUN this program the MR and MW commands will be initiallised by line 10. The MR command in line 20 will read 192 bytes of memory from locations 1024 onwards (these are the first 192 bytes of screen memory) and the MW command in line 30 will then write the same 192 bytes to memory locations 60000 onwards. This effectively means that the first 192 characters on the screen have been copied to memory locations 60000 to 60191. To see that this has in fact happened you should clear the screen and enter this short program:-

```
10 SYS $FEF5
20 MR60000
30 MW1024
40 FOR N=55296 TO 55488:POKE N,1:NEXT N
```

You should be able to follow what is happening in this program. Line 10 initiallises the MR and MW commands, line 20 reads 192 bytes of memory from memory locations 60000 onwards (this is where we stored part of the screen), and line 30 writes those 192 bytes to locations 1024 onwards (back onto the screen). Line 40 just POKEs some colour into the first 192 bytes of colour memory as some Commodore 64s need this.

The following program shows how the MR and MW commands can be used to transfer blocks of memory into a variable. Type it in and RUN it, then read the explanation to see how it works.

```
10 SYS $FEF5
20 BUFFER$=""
30 X=PEEK($2E)*256+PEEK($2D)
40 POKE X+2,192
50 POKE X+3,60
60 POKE X+4,3
70 MR $0400
80 A$=BUFFER$
90 PRINT"☛";
```

```
100 FOR N=1 TO 192
110 POKE 1023+N,ASC(MID$(A$,N,1))
120 POKE 55295+N,1
130 NEXT N
```

Here is a simple description of what each line of the program does:-

Line 10 - initiallises the MR and MW commands.
Line 20 - clears the string variable BUFFER$.
Line 30 - gives the variable X the value of the start of BASIC variables.
Line 40 - sets the length of the string to 192 bytes.
Lines 50 & 60 - specifies the start location of the string (3*256+60=828 which is the start of the tape buffer).
Line 70 - reads 192 bytes of memory from memory locations 400 (hex) onwards.
Line 80 - makes a copy of BUFFER$ in A$.
Line 90 - clears the screen.
Lines 100-130 - reads through A$ and POKEs it's contents onto the screen, and also sets the first 192 bytes of colour memory to white.

## WHAT THE FINAL CARTRIDGE WON'T DO

This is only a short section to point out the limitations (what there are of them) of The Final Cartridge. Details are given on why certain features do not always work in order to give you a fuller understanding of The Final Cartridge's capabilities.

(1) DISK TURBO

Many commercial disk-based programs are protected and have special loading routines. It is impossible to over-ride these loading routines, and so The Final Cartridge will not attempt to do so. This means that The Final Cartridge will load as much as possible at 5 times normal speed, and then allow the loader to take over loading at normal speed. However, this problem can be overcome by re-saving the program using the freeze facility.

(2) PRINTER INITIALISATION POKE

Any POKEs to memory location 56332 will remain intact until the computer is reset or turned off. This means that you do not have to use this POKE every time you use the printer.

(3) HIGH RESOLUTION SCREEN DUMPS

There are three points to note in connection with this feature:-

(i) The picture that you wish to print should be on the screen when you attempt to print it.

(ii) Although the majority of commercial games appear to use high resolution graphics and multi-colour graphics, many really use sprites and user-defined graphics, which cannot be printed by The Final Cartridge.

(iii) The Final Cartridge will produce shades of grey in place of colour for screen dumps of pictures drawn using multi-colour graphics mode, but not when extended colour mode is used. However, the majority of programs do use multi-colour graphics mode.

(4) Commercial tape programs CANNOT be made to load any faster.

We want you to be fully satisfied with The Final Cartridge, and if you encounter any problems please do not hesitate to contact H & P Computers.

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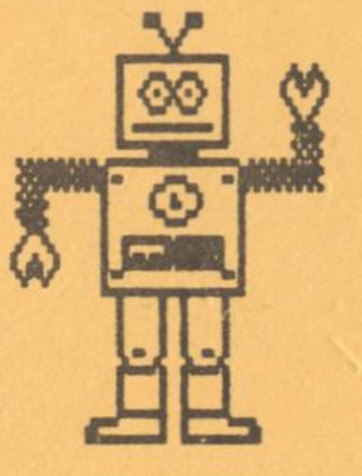

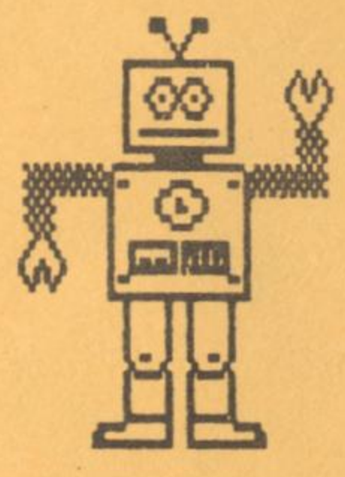
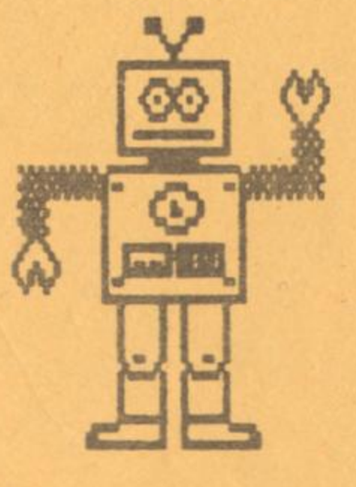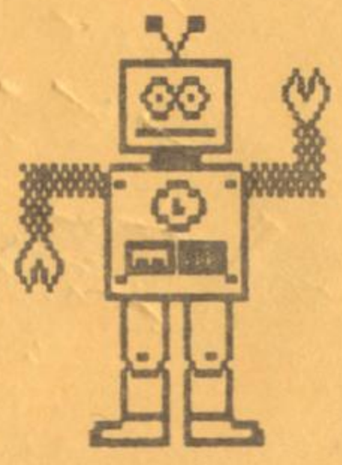
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